МГТУ им. Н. Э. Баумана, кафедра ИУ5
курс “Методы машинного обучения”

Лабораторная работа №2

«Обработка признаков (часть 1) »

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ПРОВЕРИЛ:
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Задание:

- Выбрать набор данных (датасет), содержащий категориальные и числовые признаки и пропуски в данных. Для выполнения следующих пунктов можно использовать несколько различных наборов данных (один для обработки пропусков, другой для категориальных признаков и т.д.) Просьба не использовать датасет, на котором данная задача решалась в лекции.
- Для выбранного датасета (датасетов) на основе материалов лекций решить следующие задачи:
    1. устранение пропусков в данных;
    2. кодирование категориальных признаков;
    3. нормализацию числовых признаков..
- Сформировать отчет и разместить его в своем репозитории на github.

Импортирование необходимых библиотек

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats as stats
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

[79]
```
data = pd.read_csv("/content/drive/MyDrive/data/aichi.csv")
data.head()
```

	calendar_date	avg_temperature	high_temperature	low_temperature	precipitation	hours_sunlight	solar_radiation	deepest_sr
0	2016-01-01	8.1	10.9	4.1	NaN	8.8	NaN	
1	2016-01-02	6.9	12.5	0.7	NaN	8.2	NaN	
2	2016-01-03	8.8	13.6	5.5	NaN	3.3	NaN	
3	2016-01-04	10.7	16.0	4.6	NaN	8.9	NaN	
4	2016-01-05	11.1	13.9	8.7	0.0	4.0	NaN	

[3]
```
```

[4]
```
data_features = list(zip(
# признаки
[i for i in data.columns],
zip(
    # типы колонок
    [str(i) for i in data.dtypes],
    # проверим есть ли пропущенные значения
    [i for i in data.isnull().sum()]
)))
# Признаки с типом данных и количеством пропусков
data_features
```

```
[('calendar_date', ('object', 0)),
 ('avg_temperature', ('float64', 0)),
 ('high_temperature', ('float64', 0)),
 ('low_temperature', ('float64', 0)),
 ('precipitation', ('float64', 238)),
 ('hours_sunlight', ('float64', 0)),
 ('solar_radiation', ('float64', 517)),
 ('deepest_snowfall', ('float64', 517)),
 ('total_snowfall', ('float64', 517)),
 ('avg_wind_speed', ('float64', 0)),
 ('avg_vapor_pressure', ('float64', 3)),
 ('avg_local_pressure', ('float64', 0)),
 ('avg_humidity', ('float64', 3)),
 ('avg_sea_pressure', ('float64', 0)),
 ('cloud_cover', ('float64', 517))]
```

Устранение пропусков

```
# Доля (процент) пропусков
[(c, data[c].isnull().mean()) for c in data.columns]
```

```
[('calendar_date', 0.0),
 ('avg_temperature', 0.0),
 ('high_temperature', 0.0),
 ('low_temperature', 0.0),
 ('precipitation', 0.46034816247582205),
 ('hours_sunlight', 0.0),
 ('solar_radiation', 1.0),
 ('deepest_snowfall', 1.0),
 ('total_snowfall', 1.0),
 ('avg_wind_speed', 0.0),
 ('avg_vapor_pressure', 0.005802707930367505),
 ('avg_local_pressure', 0.0),
 ('avg_humidity', 0.0),
 ('avg_sea_pressure', 0.0),
 ('cloud_cover', 1.0)]
```

```
[66] # Удаление колонок, содержащих пустые значения
clear_df = data
clear_df = clear_df.dropna(axis=1, how='any')
clear_df.isnull().sum()
```

```
calendar_date         0
avg_temperature       0
high_temperature      0
low_temperature       0
hours_sunlight        0
avg_wind_speed        0
avg_local_pressure    0
avg_humidity          0
avg_sea_pressure      0
dtype: int64
```

```
[67] # Удаление строк
clear_df = data.dropna(axis=0, how='any')
clear_df.isnull().sum()
```

```
calendar_date         0.0
avg_temperature       0.0
high_temperature      0.0
low_temperature       0.0
precipitation         0.0
hours_sunlight        0.0
solar_radiation       0.0
deepest_snowfall      0.0
total_snowfall        0.0
avg_wind_speed        0.0
avg_vapor_pressure    0.0
avg_local_pressure    0.0
avg_humidity          0.0
avg_sea_pressure      0.0
cloud_cover           0.0
dtype: float64
```

```
[80] # Заполним пропуски возраста средними значениями
def impute_na(df, variable, value):
    df[variable].fillna(value, inplace=True)
hcols_with_na_temp = ['solar_radiation', 'deepest_snowfall', 'total_snowfall','precipitation','cloud_cover']
data.drop(hcols_with_na_temp, inplace=True, axis=1)
impute_na(data, 'avg_humidity', 0)
impute_na(data, 'avg_vapor_pressure', data['avg_vapor_pressure'].mean())
```

```
[80] # Заполним пропуски возраста средними значениями
     def impute_na(df, variable, value):
         df[variable].fillna(value, inplace=True)
     hcols_with_na_temp = ['solar_radiation', 'deepest_snowfall', 'total_snowfall','precipitation','cloud_cover']
     data.drop(hcols_with_na_temp, inplace=True, axis=1)
     impute_na(data, 'avg_humidity', 0)
     impute_na(data, 'avg_vapor_pressure', data['avg_vapor_pressure'].mean())
```

```
# Убедимся, что признак avg_humidity не имеет пустых значений
data.isnull().sum()
```

```
calendar_date         0
avg_temperature       0
high_temperature      0
low_temperature       0
hours_sunlight        0
avg_wind_speed        0
avg_vapor_pressure    0
avg_local_pressure    0
avg_humidity          0
avg_sea_pressure      0
dtype: int64
```

Кодирование категориальных признаков

```
[83] from sklearn.preprocessing import LabelEncoder
```

```
[101] data = pd.read_csv("/content/drive/MyDrive/data/seattle-weather.csv")
      data.head()
```

	date	precipitation	temp_max	temp_min	wind	weather
0	2012-01-01	0.0	12.8	5.0	4.7	drizzle
1	2012-01-02	10.9	10.6	2.8	4.5	rain
2	2012-01-03	0.8	11.7	7.2	2.3	rain
3	2012-01-04	20.3	12.2	5.6	4.7	rain
4	2012-01-05	1.3	8.9	2.8	6.1	rain

```
[112] # Убедимся что нет пустых значений
      data.isnull().sum()
```

```
date              0
precipitation     0
temp_max          0
temp_min          0
wind              0
weather           0
wind_log          0
wind_reciprocal   0
wind_sqr          0
wind_exp1         0
wind_exp2         0
wind_exp3         0
wind_boxcox       0
dtype: int64
```

```
[113]
      le = LabelEncoder()
      cat_enc_le = le.fit_transform(data['weather'])
```

```
[114] data['weather'].unique()
```

```
array(['drizzle', 'rain', 'sun', 'snow', 'fog'], dtype=object)
```

```
[115] np.unique(cat_enc_le)
```

```
array([0, 1, 2, 3, 4])
```

```
[117] le.inverse_transform([0, 1, 2, 3, 4])
```

```
array(['drizzle', 'fog', 'rain', 'snow', 'sun'], dtype=object)
```

```
[122] data['weather'].unique()
```

```
array(['drizzle', 'rain', 'sun', 'snow', 'fog'], dtype=object)
```

```
pip install category_encoders
```

```
Collecting category_encoders
  Downloading category_encoders-2.4.0-py2.py3-none-any.whl (86 kB)
     |████████████████████████████████| 86 kB 2.8 MB/s
Requirement already satisfied: scipy>=1.0.0 in /usr/local/lib/python3.7/dist-packages (from category_encoders) (1.4.1)
Requirement already satisfied: scikit-learn>=0.20.0 in /usr/local/lib/python3.7/dist-packages (from category_encoders)
Requirement already satisfied: patsy>=0.5.1 in /usr/local/lib/python3.7/dist-packages (from category_encoders) (0.5.2)
Requirement already satisfied: numpy>=1.14.0 in /usr/local/lib/python3.7/dist-packages (from category_encoders) (1.21.
Requirement already satisfied: pandas>=0.21.1 in /usr/local/lib/python3.7/dist-packages (from category_encoders) (1.3.
Requirement already satisfied: statsmodels>=0.9.0 in /usr/local/lib/python3.7/dist-packages (from category_encoders) (
Requirement already satisfied: python-dateutil>=2.7.3 in /usr/local/lib/python3.7/dist-packages (from pandas>=0.21.1->
Requirement already satisfied: pytz>=2017.3 in /usr/local/lib/python3.7/dist-packages (from pandas>=0.21.1->category_e
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from patsy>=0.5.1->category_encoders) (1
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.7/dist-packages (from scikit-learn>=0.20
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.7/dist-packages (from scikit-learn>=0.20.0->cate
Installing collected packages: category-encoders
Successfully installed category-encoders-2.4.0
```

```
[119] #CountEncoder
      from category_encoders.count import CountEncoder as ce_CountEncoder
```

```
/usr/local/lib/python3.7/dist-packages/statsmodels/tools/_testing.py:19: FutureWarning: pandas.util.testing is deprecat
  import pandas.util.testing as tm
```

```
[127] ce_CountEncoder1 = ce_CountEncoder()
      data_COUNT_ENC = ce_CountEncoder1.fit_transform(data[data.columns.difference(['wind'])])
```

```
[128] data_COUNT_ENC.head()
```

	date	precipitation	temp_max	temp_min	weather	wind_boxcox	wind_exp1	wind_exp2	wind_exp3	wind_log	wind_recip
0	1	0.0	12.8	5.0	53	1.956277	2.805855	22.09	1.674205	1.547563	0.2
1	1	10.9	10.6	2.8	641	1.888392	2.725681	20.25	1.650136	1.504077	0.2
2	1	0.8	11.7	7.2	641	0.942893	1.742416	5.29	1.319640	0.832909	0.4
3	1	20.3	12.2	5.6	641	1.956277	2.805855	22.09	1.674205	1.547563	0.2
4	1	1.3	8.9	2.8	641	2.381883	3.338514	37.21	1.826059	1.808289	0.1

```
[130] data['weather'].unique()
```

```
array(['drizzle', 'rain', 'sun', 'snow', 'fog'], dtype=object)
```

```
[131] data_COUNT_ENC['weather'].unique()
```

```
array([ 53, 641, 640,  26, 101])
```

```
[130] data['weather'].unique()
```

```
array(['drizzle', 'rain', 'sun', 'snow', 'fog'], dtype=object)
```

```
data_COUNT_ENC['weather'].unique()
```

```
array([ 53, 641, 640,  26, 101])
```

```
[132] ce_CountEncoder2 = ce_CountEncoder(normalize=True)
      data_FREQ_ENC = ce_CountEncoder2.fit_transform(data[data.columns.difference(['wind'])])
```

```
[133] data_FREQ_ENC['weather'].unique()
```

```
array([0.03627652, 0.43874059, 0.43805613, 0.01779603, 0.06913073])
```

```
[134] from category_encoders.helmert import HelmertEncoder as ce_HelmertEncoder
```

```
[135] #HelmetEncoder
      ce_HelmertEncoder1 = ce_HelmertEncoder()
      data_HELM_ENC = ce_HelmertEncoder1.fit_transform(data[data.columns.difference(['wind'])], data['wind'])
```

```
[137] data_HELM_ENC.head(100)
```

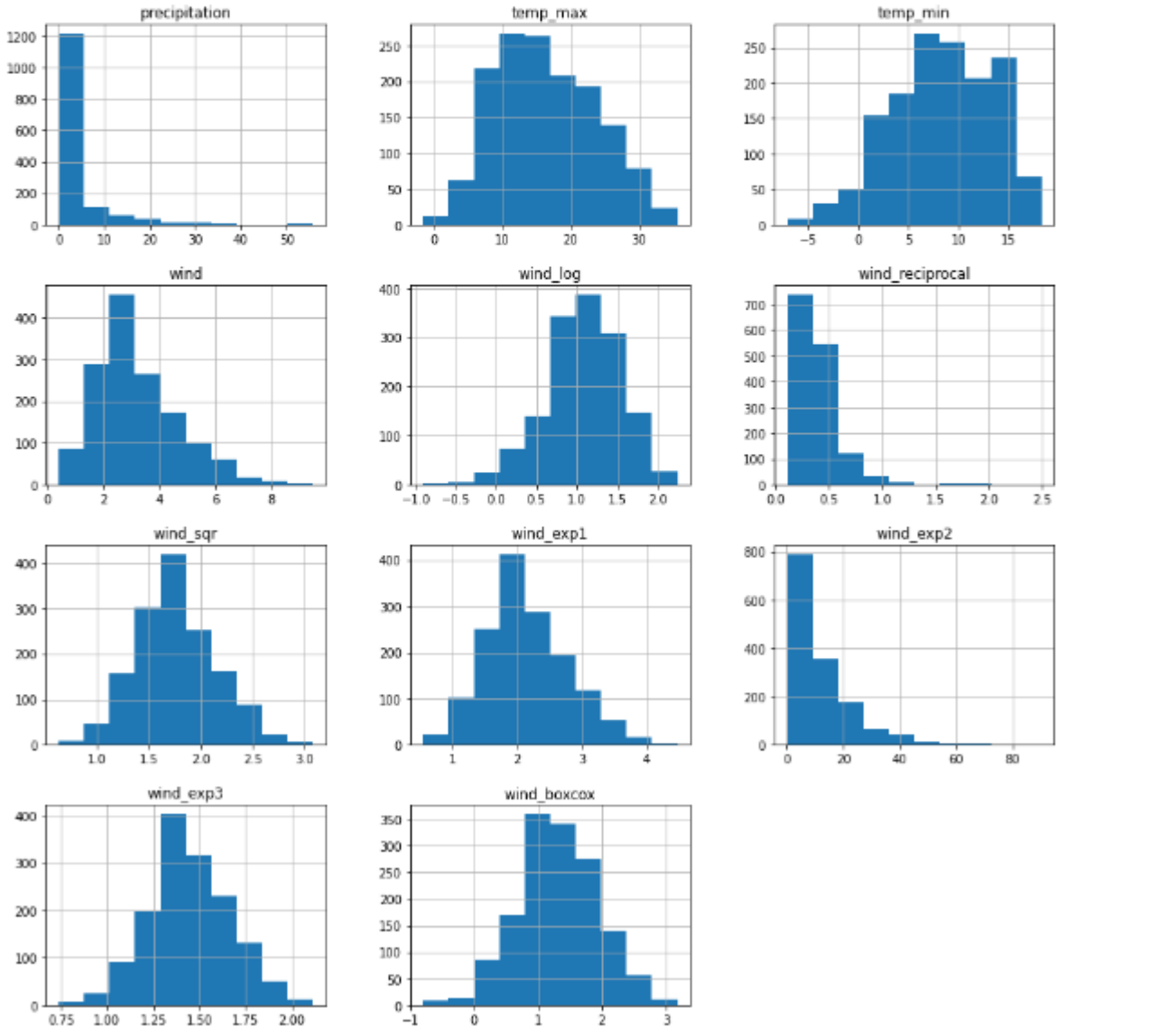
	intercept	date_0	date_1	date_2	date_3	date_4	date_5	date_6	date_7	date_8	...	weather_1	weather_2	weather_3	wind_boxcox
0	1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	...	-1.0	-1.0	-1.0	1.956277
1	1	1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	...	-1.0	-1.0	-1.0	1.888392
2	1	0.0	2.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	...	-1.0	-1.0	-1.0	0.942893
3	1	0.0	0.0	3.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	...	-1.0	-1.0	-1.0	1.956277
4	1	0.0	0.0	0.0	4.0	-1.0	-1.0	-1.0	-1.0	-1.0	...	-1.0	-1.0	-1.0	2.381883
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
95	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	3.0	-1.0	0.641225
96	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	-1.0	-1.0	-1.0	1.102072
97	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	2.0	-1.0	-1.0	1.818335
98	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	2.0	-1.0	-1.0	1.745931
99	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	2.0	-1.0	-1.0	0.828409

100 rows × 1475 columns

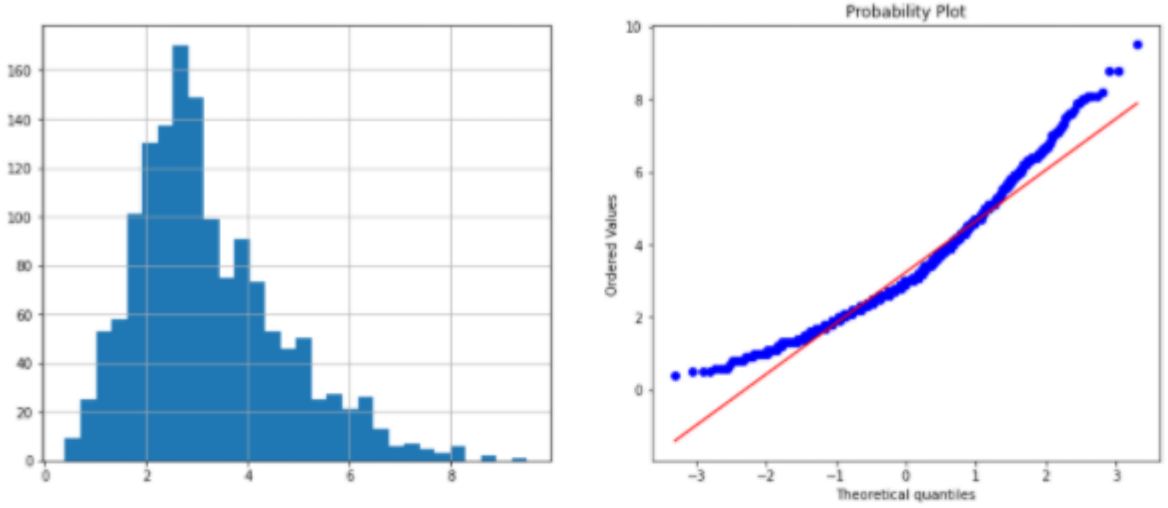
Нормализация числовых признаков

```
[98] def diagnostic_plots(df, variable):
         plt.figure(figsize=(15,6))
         plt.subplot(1, 2, 1)
         df[variable].hist(bins=30)
         plt.subplot(1, 2, 2)
         stats.probplot(df[variable], dist="norm", plot=plt)
         plt.show()
```

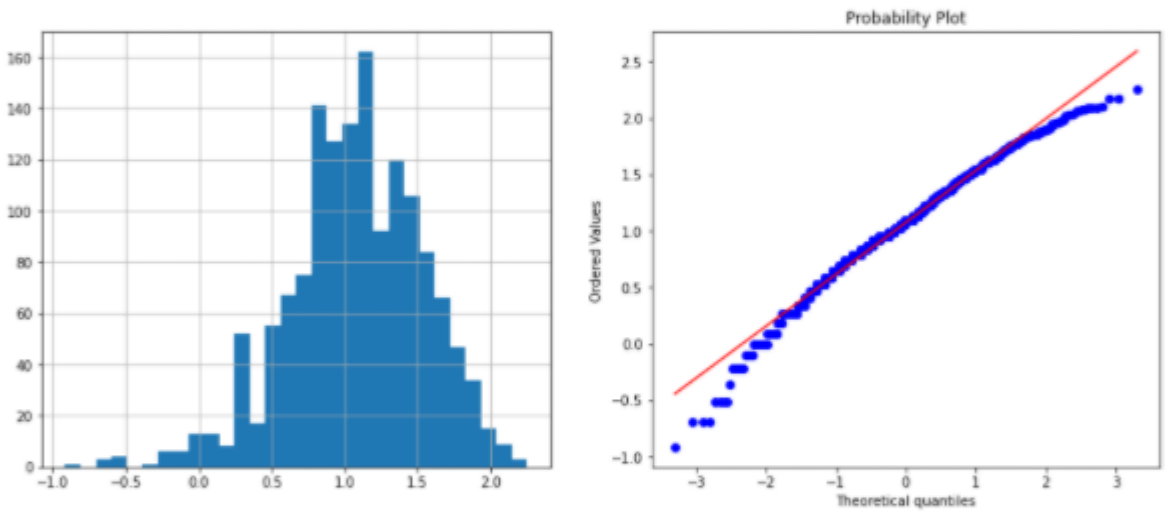
```
data.hist(figsize=(15,15))
plt.show()
```



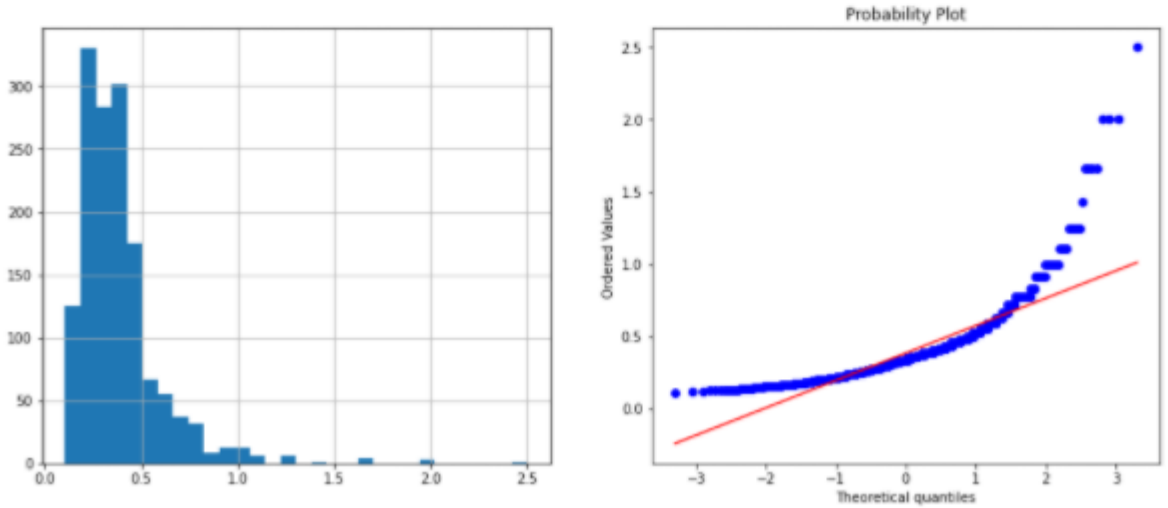
```
[103] diagnostic_plots(data, 'wind')
```



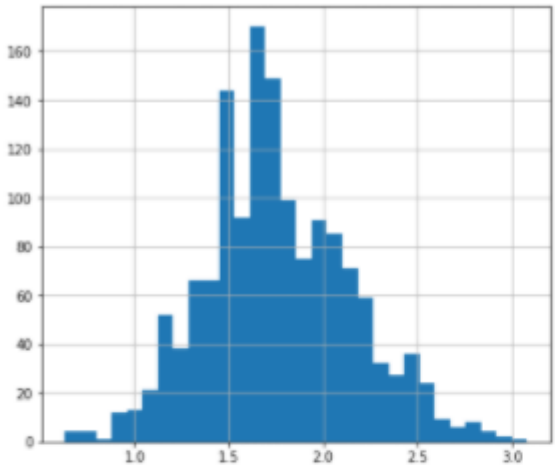

```
[104] #Логарифмическое преобразование
      data['wind_log'] = np.log(data['wind'])
      diagnostic_plots(data, 'wind_log')
```

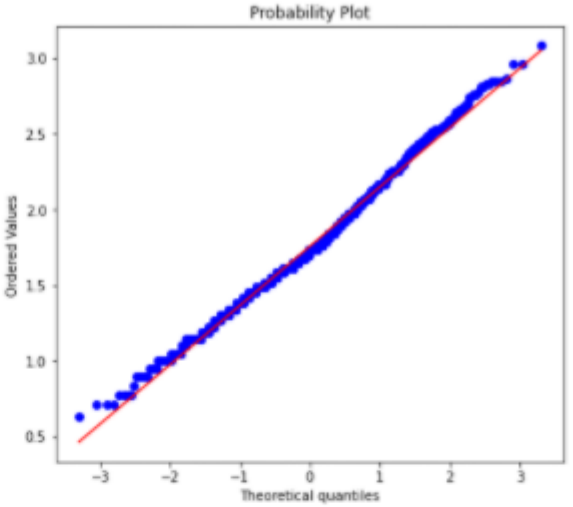



```
#Обратное преобразование
data['wind_reciprocal'] = 1 / (data['wind'])
diagnostic_plots(data, 'wind_reciprocal')
```

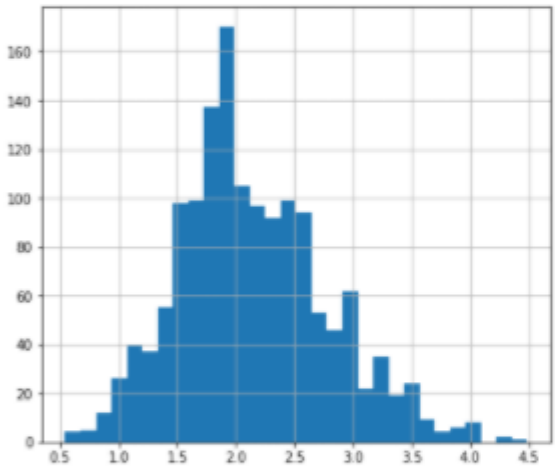


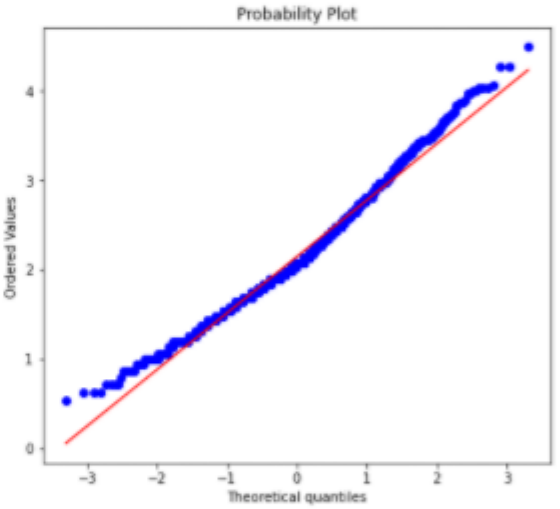
```
[106] #Квадратный корень
      data['wind_sqr'] = data['wind']**(1/2)
      diagnostic_plots(data, 'wind_sqr')
```



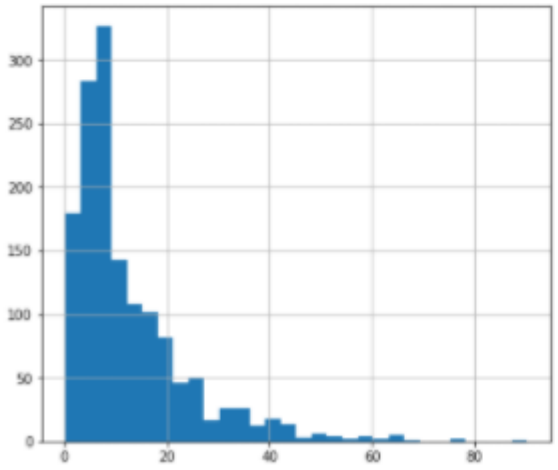


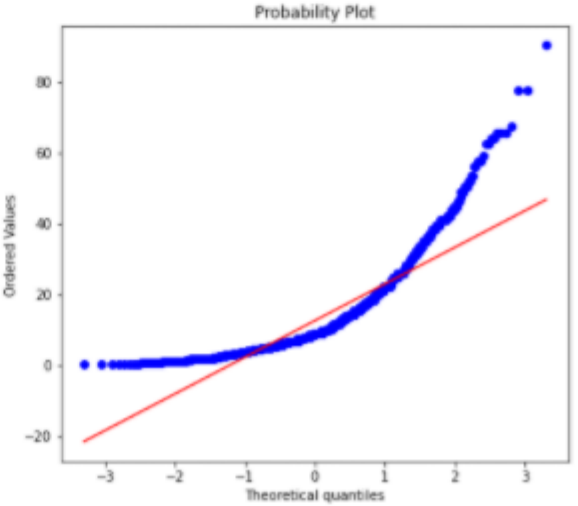

```
[107] #Возведение в степень
      data['wind_exp1'] = data['wind']**(1/1.5)
      diagnostic_plots(data, 'wind_exp1')
```



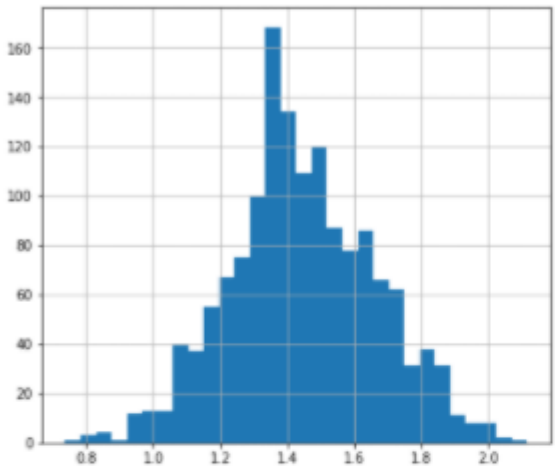


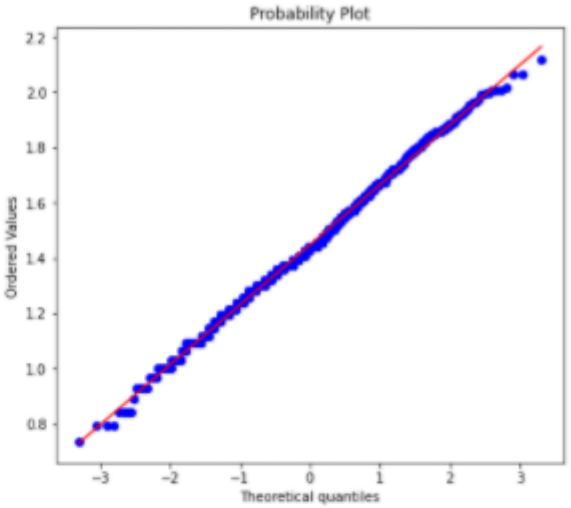

```
      data['wind_exp2'] = data['wind']**(2)
      diagnostic_plots(data, 'wind_exp2')
```





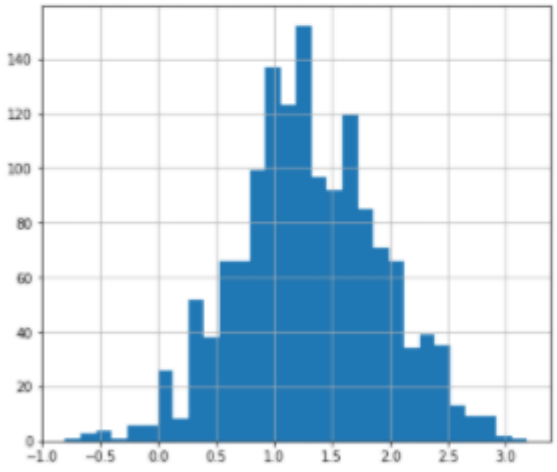
```
[110] data['wind_exp3'] = data['wind']**(0.333)
      diagnostic_plots(data, 'wind_exp3')
```

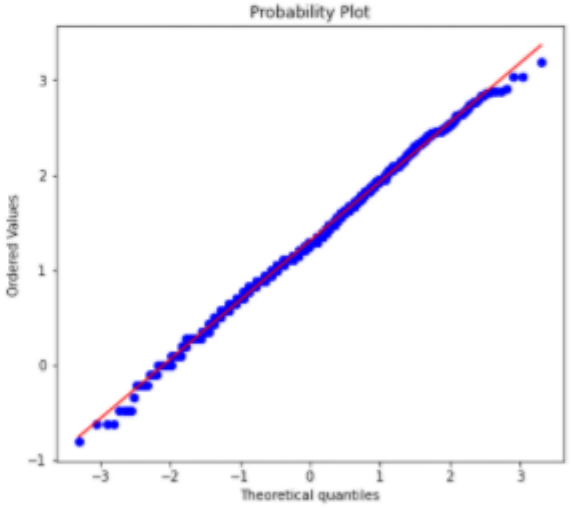





```
[111] #Преобразование Бокса-Кокса
      data['wind_boxcox'], param = stats.boxcox(data['wind'])
      print('Оптимальное значение λ = {}'.format(param))
      diagnostic_plots(data, 'wind_boxcox')
```

```
Оптимальное значение λ = 0.2919088037899124
```






```
[ ]
```